

Claims

I claim:

1 1. A method for separating components in individual signals, comprising:
 2 acquiring concurrently a plurality of individual signals generated by a
 3 plurality of sources by a single sensor;
 4 constructing an input non-negative matrix representing the plurality of
 5 individual signals, the input non-negative matrix including columns
 6 representing features of the plurality of individual signals at different
 7 instances in time; and
 8 factoring the first non-negative matrix into a set of non-negative bases
 9 matrices and a non-negative weight matrix, the set of bases matrices and the
 10 weight matrix representing the plurality of individual signals at the different
 11 instances of time.

1 2. The method of claim 1, in which there is one non-negative bases matrix
 2 for each individual signal.

1 3. The method of claim 1, in which the input non-negative matrix is \mathbf{V} , the
 2 set of non-negative bases matrices is \mathbf{W}_t , and the non-negative weight matrix

3 is \mathbf{H} such that
$$\mathbf{V} \approx \sum_{t=0}^{T-1} \mathbf{W}_t \cdot \vec{t} \cdot \mathbf{H}$$
,

4 where $\mathbf{V} \in \mathcal{R}^{\geq 0, M \times N}$ is the input non-negative matrix to be factored, the set of
 5 non-negative bases matrices is $\mathbf{W}_t \in \mathcal{R}^{\geq 0, M \times R}$, and the non-negative weight

6 matrix is $\mathbf{H} \in \mathcal{R}^{\geq 0, R \times V}$ over successive time intervals t , and an operator $(\cdot)^{\overleftarrow{t}}$
7 shifts columns of corresponding matrices by i time increments to the right.

1 4. The method of claim 3, further comprising:
2 shifting left most corresponding columns of the matrix \mathbf{H} to zero to
3 maintain an original size of the matrix \mathbf{H} when the operator $(\cdot)^{\overleftarrow{t}}$ is applied.

1 5. The method of claim 1, further comprising:
2 reconstructing the input non-negative matrix from the set of non-
3 negative bases matrices and the non-negative weight matrices.

1 6. The method of claim 5, in which the reconstructing is according to

$$2 \quad \mathbf{V} \approx \sum_{t=0}^{T-1} \mathbf{W}_t \cdot \mathbf{H}^{\overleftarrow{t}} .$$

1 7. The method of claim 6, further comprising;
2 measuring on error of the reconstructing by a cost function

$$3 \quad D = \left\| \mathbf{V} \otimes \ln\left(\frac{\mathbf{V}}{\mathbf{\Lambda}}\right) - \mathbf{V} + \mathbf{\Lambda} \right\|_F ,$$

4 where $\mathbf{\Lambda} = \sum_{t=0}^{T-1} \mathbf{W}_t \cdot \mathbf{H}^{\overleftarrow{t}}$.

1 8. The method of claim 5, further comprising:
2 updating the cost function for each iteration of t according to

$$3 \quad \mathbf{H} = \mathbf{H} \otimes \frac{\mathbf{W}_t^T \cdot [\frac{\mathbf{V}}{\mathbf{\Lambda}}]^{\overleftarrow{t}}}{\mathbf{W}_t^T \cdot \mathbf{1}} \text{ and } \mathbf{W}_t = \mathbf{W}_t \otimes \frac{\frac{\mathbf{V}}{\mathbf{\Lambda}} \cdot \mathbf{H}^{\overleftarrow{t}}}{\mathbf{1} \cdot \mathbf{H}^{\overleftarrow{t}}}, \quad \forall t \in [0 \dots T-1] ,$$

4 where an inverse operation (\leftarrow) shifts columns of corresponding matrices to
5 the left by i time increments.

1 9. The method of claim 5, in which the reconstructing is partial to generate
2 an output non-negative matrix representing a selected one of the plurality of
3 individual signals to perform source separation.

1 10. The method of claim 1 in which the first non-negative matrix represents
2 a plurality of acoustic signals, each acoustic signal generated by a different
3 source.

1 11. The method of claim 10, in which columns of the set of non-negative
2 bases matrices columns represent spectral features of the plurality of
3 acoustic signals, and rows of the non-negative weight matrix represent
4 instances in time when the spectral features occur.

1 12. The method of claim 1, in which the first non-negative matrix represents
2 a plurality of time series data streams.

1 13. The method of claim 1, further comprising:
2 performing source separation on the

1 14. A system separating components in individual signals, comprising:
2 a single sensor configured to acquire concurrently a plurality of
3 individual signals generated by a plurality of source;

4 a buffer configured to store an input non-negative matrix representing
5 the plurality of individual signals, the input non-negative matrix including
6 columns representing features of the plurality of individual signals at
7 different instances in time; and
8 means for factoring the first non-negative matrix into a set of non-
9 negative bases matrices and a non-negative weight matrix, the set of bases
10 matrices and the weight matrix representing the plurality of individual
11 signals at the different instances of time.